



Armed Forces College of Medicine AFCM



Physiology of Female Reproductive System 1

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Endocrine & Genitourinary Module

INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student should be able to:

- 1. Explain the physiologic changes that occur in the female reproductive organs during the menstrual cycle (ovarian cycle - uterine cycle).**
- 2. Name the key hormones secreted by graafian follicles and corpora lutea of**

Function of Female Reproductive System



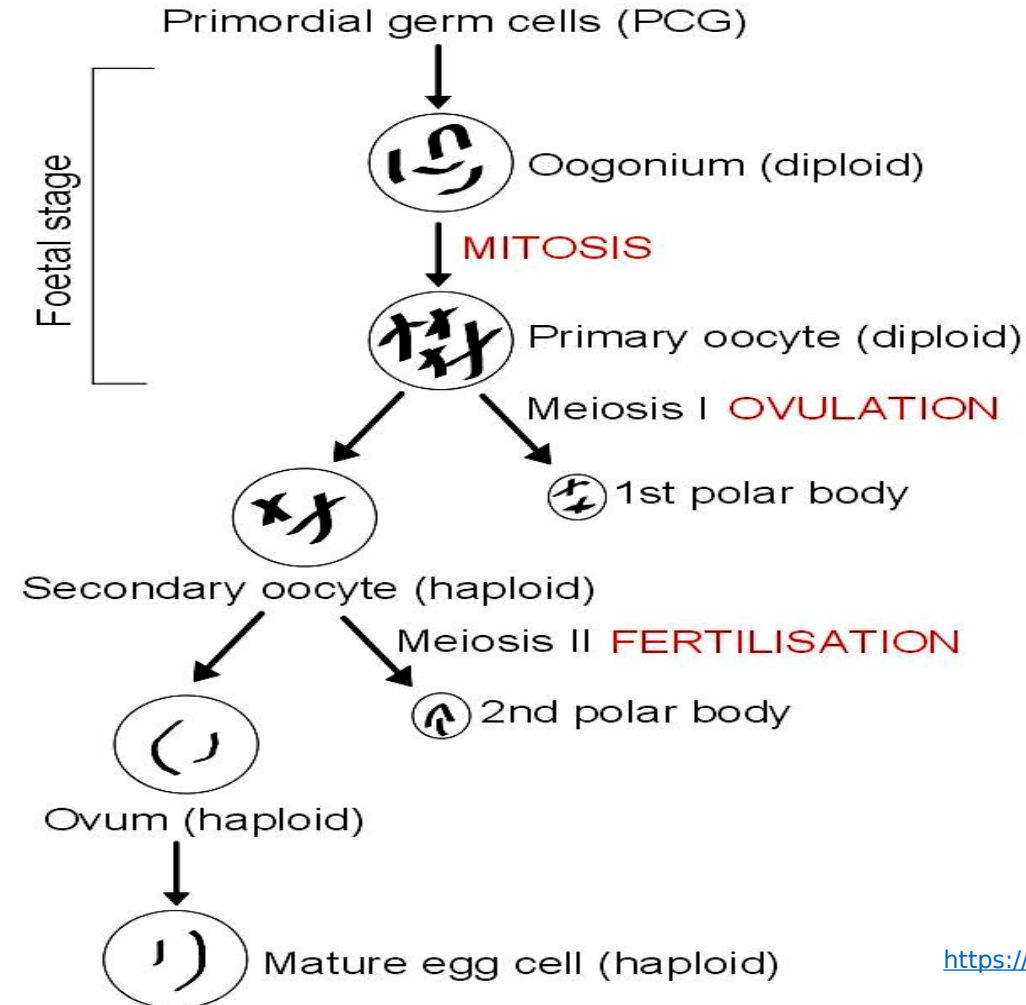
- ❖ **Production of ova (Oogenesis)**
- ❖ **Reception of sperm**
- ❖ **Maintenance of developing fetus (pregnancy)**
- ❖ **Giving birth to baby & lactation**

Function of Ovaries



- ❖ **Oogenesis (production of ova)**
- ❖ **Secretion of estrogen & progesterone**

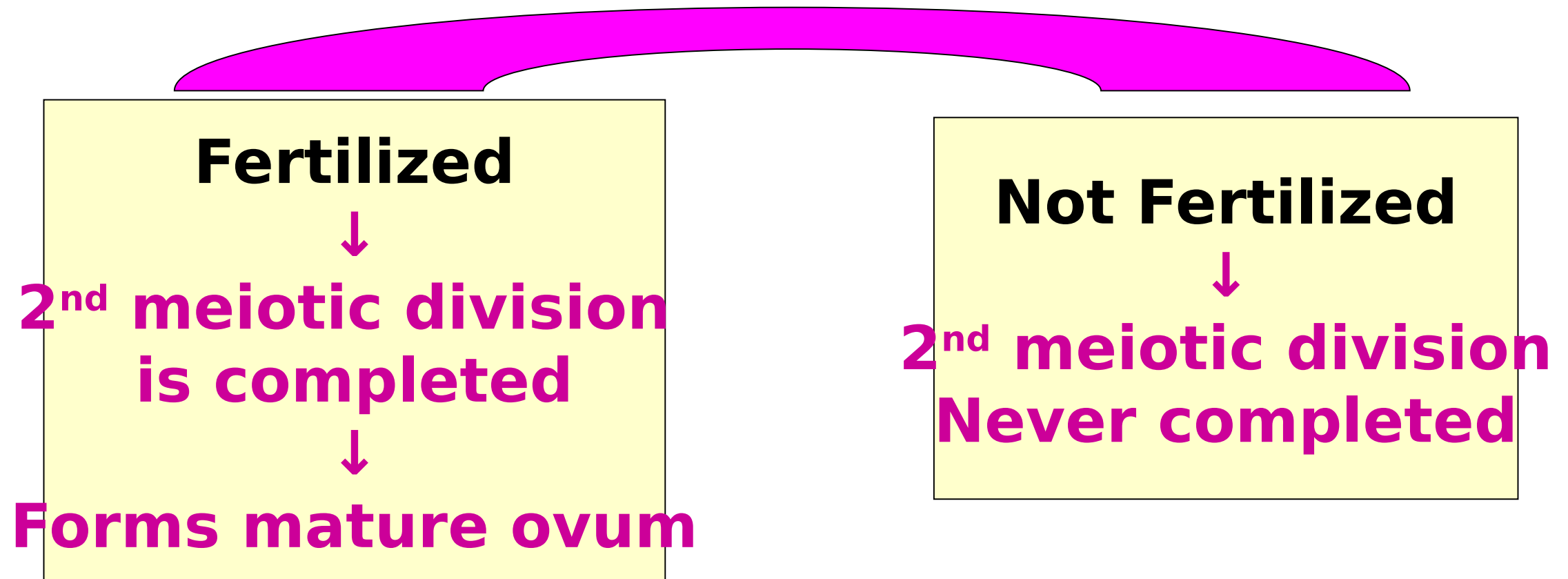
Oogenesis



<https://www.pinterest.com/pin/74802043786482545/?lp=true>



- **2^{ary} oocyte (not mature ovum) is ovulated and starts 2nd meiotic division**



Menstrual Cycle



- ❖ **Female reproductive system shows regular cyclic changes which are periodic preparations for fertilization and pregnancy.**
- ❖ **The cycle is called menstrual cycle.**



- ❖ **Most obvious is periodic vaginal bleeding that occurs with shedding of the uterine mucosa (menstruation).**
- ❖ **Length of cycle is variable in women, but an average is 28 days from the start of one menstrual period to the start of the next.**



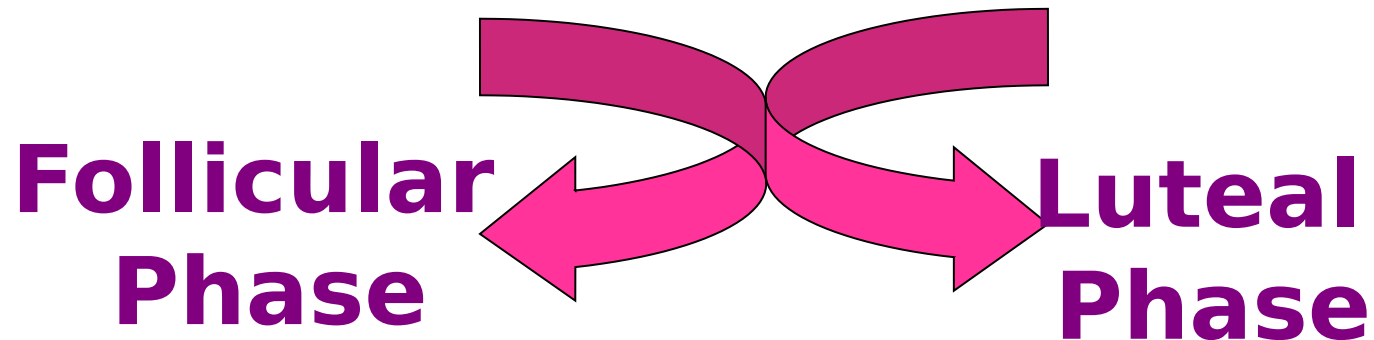
❖ **The menstrual cycle involves cyclic changes in 2 organs:**

- **Ovary (the ovarian cycle)**
- **Uterus (the endometrial cycle)**

Ovarian Cycle



- ❖ **Starts after onset of puberty**
- ❖ **Average 28 days**
- ❖ **Is interrupted by pregnancy**
- ❖ **Is terminated by menopause**

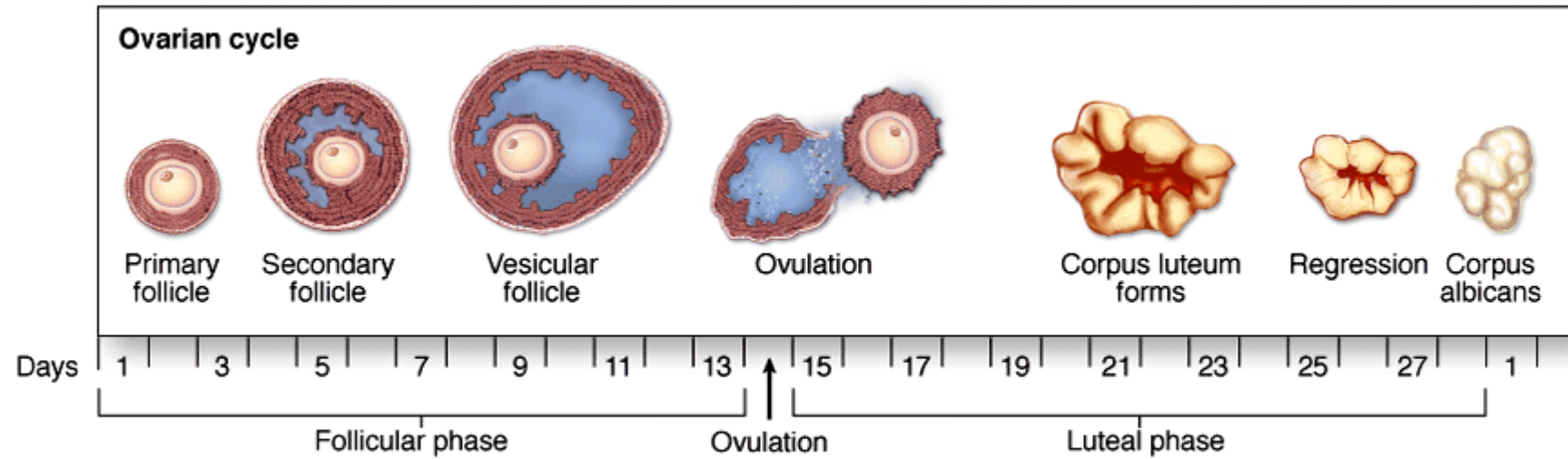


Follicular

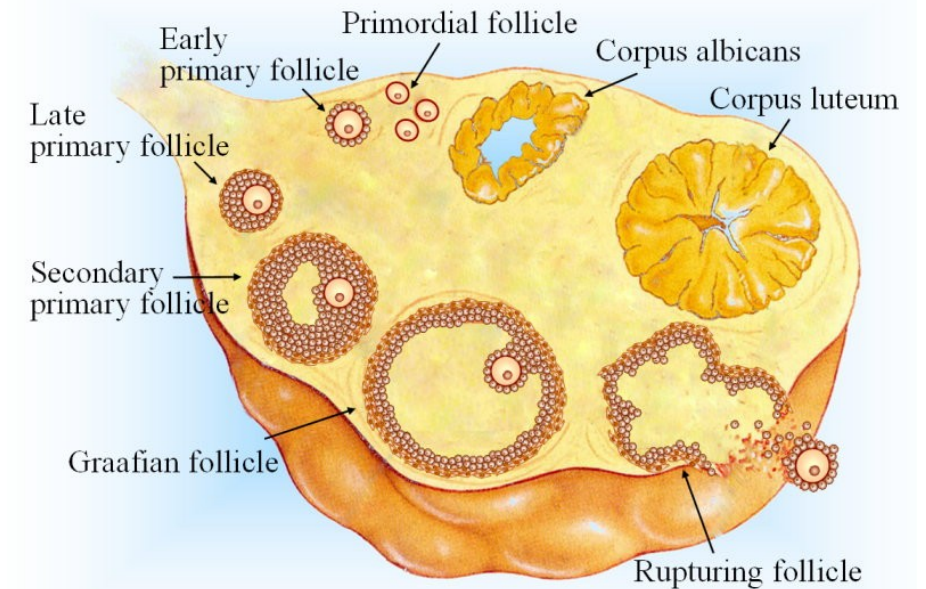


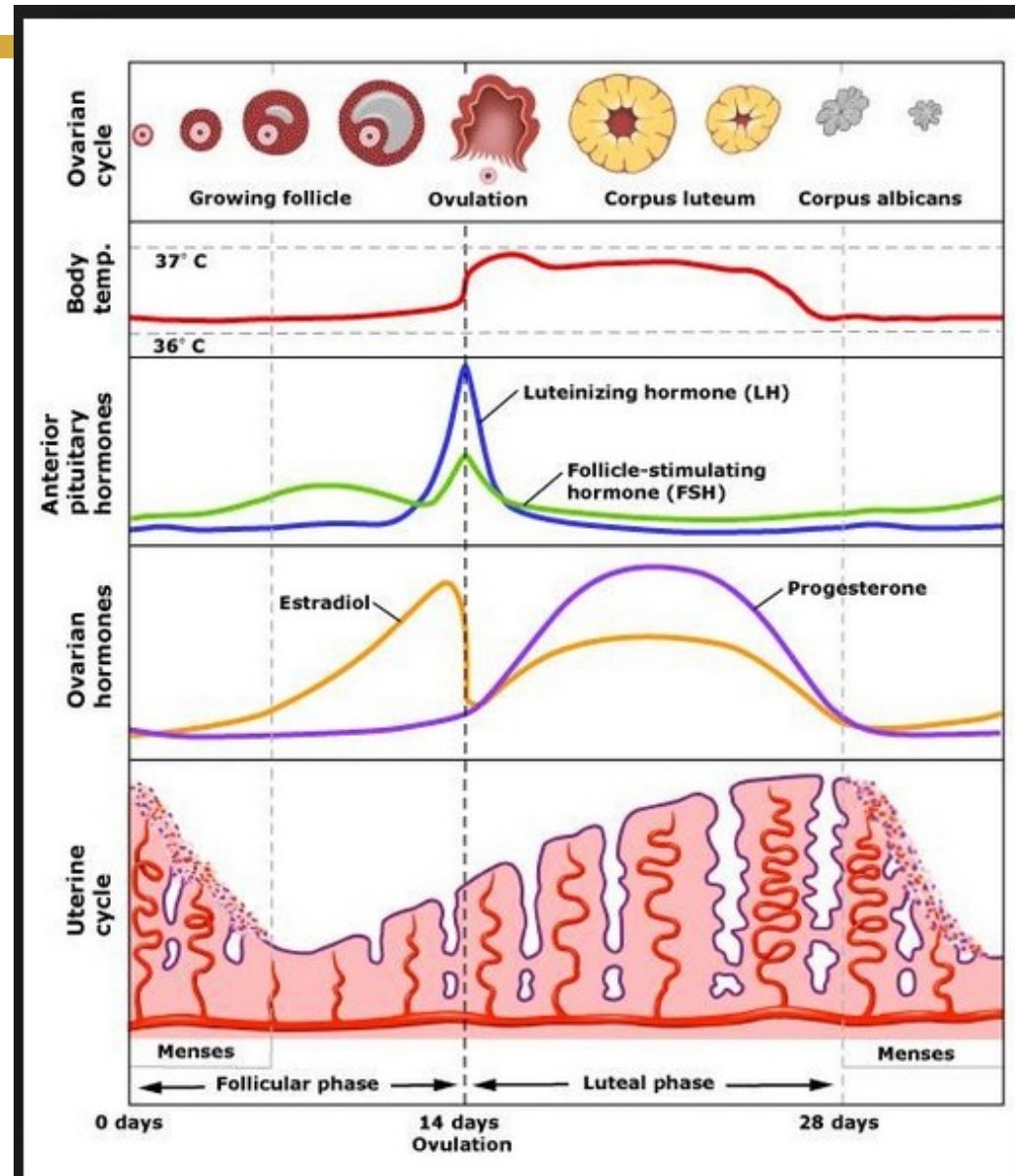
Phase

- ❖ It occurs in the first half of the cycle (first 14 days)
- ❖ At the start of each cycle, under the influence of **FSH**, several primordial follicles enlarge and a cavity forms around ovum (antrum formation) & the follicle is now called **antral or secondary**



Source: Mescher AL: *Junqueira's Basic Histology: Text and Atlas, 12th Edition*: <http://www.accessmedicine.com>
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- ❖ **This cavity is filled with follicular fluid which originates partially from**
 - ▶ **Transudation of plasma**
 - ▶ **Follicular cell secretion**



- ❖ **The shift to an antral follicle initiates rapid follicular growth.**
- ❖ **During this time, the ovum itself also enlarges and the follicle increases in size.**



❖ **Part of the follicular growth is**

- **the result of continued proliferation of the granulosa & theca cells**
- **but most results from a dramatic expansion of the antrum**

On about 6th day



❖ One of the follicles in one ovary starts to grow rapidly and becomes the dominant follicle (Graafian follicle)

❖ While the others regress, forming



- ❖ **It is uncertain how one follicle is selected to be the dominant follicle in follicular phase of menstrual cycle**
- ❖ **It seems to be related to the ability of the follicle to secrete the estrogen inside it that is needed for final maturation.**



- ❖ **The primary source of circulating estrogen is the granulosa cells of ovaries**
- ❖ **Cells of theca interna of the follicle are necessary for production of estrogen**
- ❖ **As they secrete androgens that are aromatized to estrogen by the granulosa cells.**



- ❖ **Near midcycle (at about the 14th day), estrogen secretion from the follicle is excessively raised**
- ❖ **The markedly ↑ plasma estrogen level through a +ve feedback mechanism triggers a burst of luteinizing hormone (LH) secretion called **LH surge****
- ❖ **Probably by augmenting the response of anterior pituitary gland to GnRH**



❖ **Such LH surge**

❖ → **full maturation of the follicle then ovulation which occurs about 9 h after the LH peak.**

❖ **Ovulation is rupture of mature graafian follicle & release of ovum which is extruded into abdominal cavity.**



❖ **The ovum is picked up by the fimbriated ends of the uterine tubes (oviducts) and either:**

❖ **If the ovum is fertilized**

→ **it is transported to the uterus**

❖ **If not fertilized**

→ **it will be lost out through vagina**

Luteal Phase



- ❖ It occupies second half of cycle (last 14 days)
- ❖ The follicle that ruptures at time of ovulation is filled with blood, forming a **corpus hemorrhagicum**.
- ❖ Minor bleeding from follicle into abdominal cavity may cause peritoneal irritation leading to lower abdominal pain.



- ❖ **The granulosa and theca cells of the follicle begin to proliferate**
- ❖ **The clotted blood is rapidly replaced with yellowish, lipid rich luteal cells, forming the corpus luteum.**
- ❖ **The luteal cells secrete progesterone and estrogen**



- ❖ **The CL continues to grow and reaches full maturation on about the 21st day of the cycle**
- ❖ **And its hormones prepare uterine endometrium for implantation of the ovum (if fertilized)**



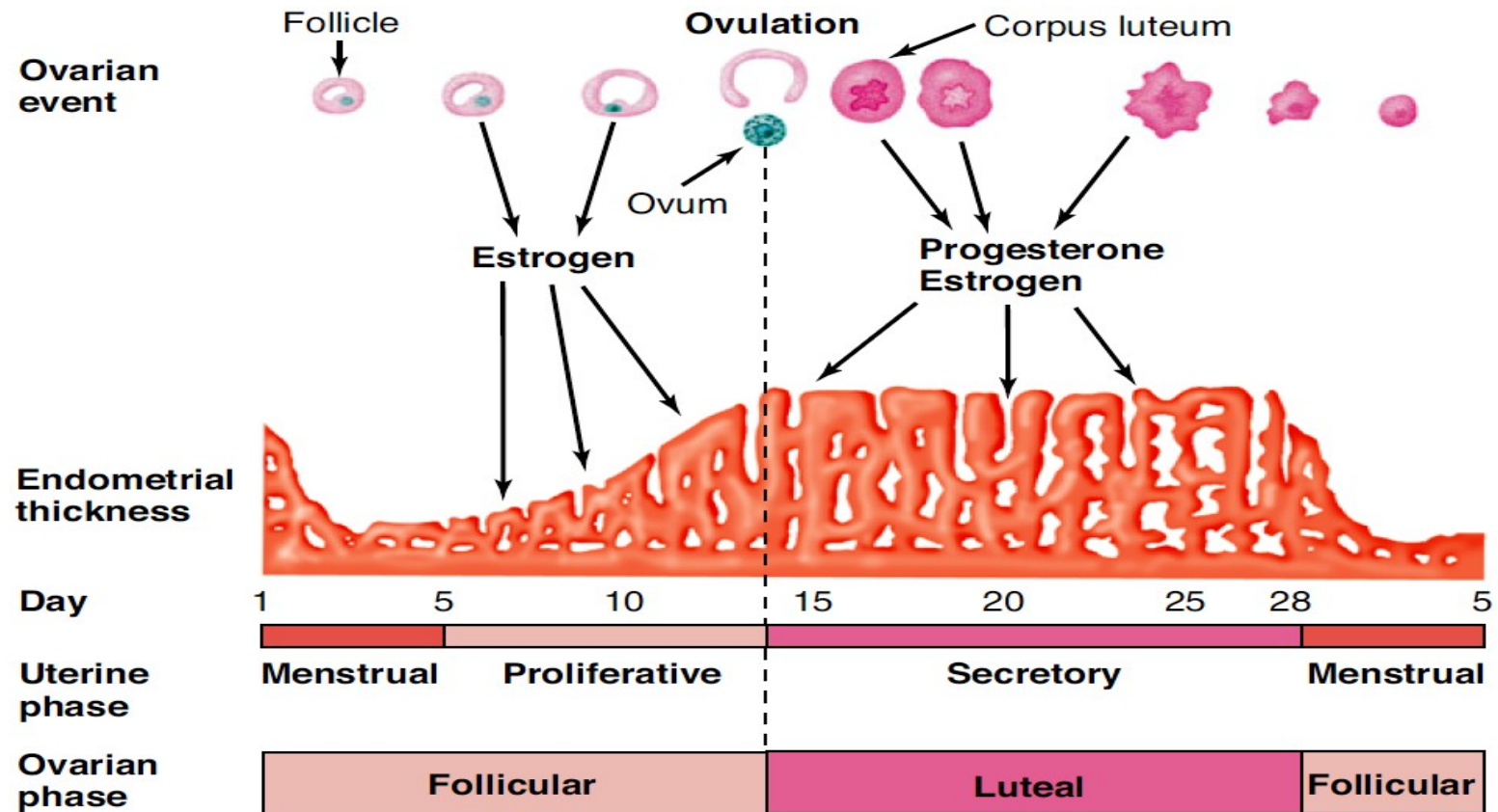
❖ **If pregnancy (fertilization & implantation) occurs**

→ CL persists and continues to secrete its hormones and is called corpus luteum of pregnancy.

❖ **If pregnancy does not occur**

→ CL begins to degenerate about 4 days

before the next menses (24th day of the



Uterine Cycle

(Endometrial Cycle)



- ❖ **Cyclic changes in uterus due to changes in levels of estrogen & progesterone during ovarian cycle**
- ❖ **Duration average 28 days**
- ❖ **Prepares uterus for implantation of fertilized ovum & maintenance of early**



Phases of Uterine

Cycle

- **Proliferative phase**

(Preovulatory or follicular phase)

- **Secretory phase**

(Luteal phase)

- **Menstrual phase**

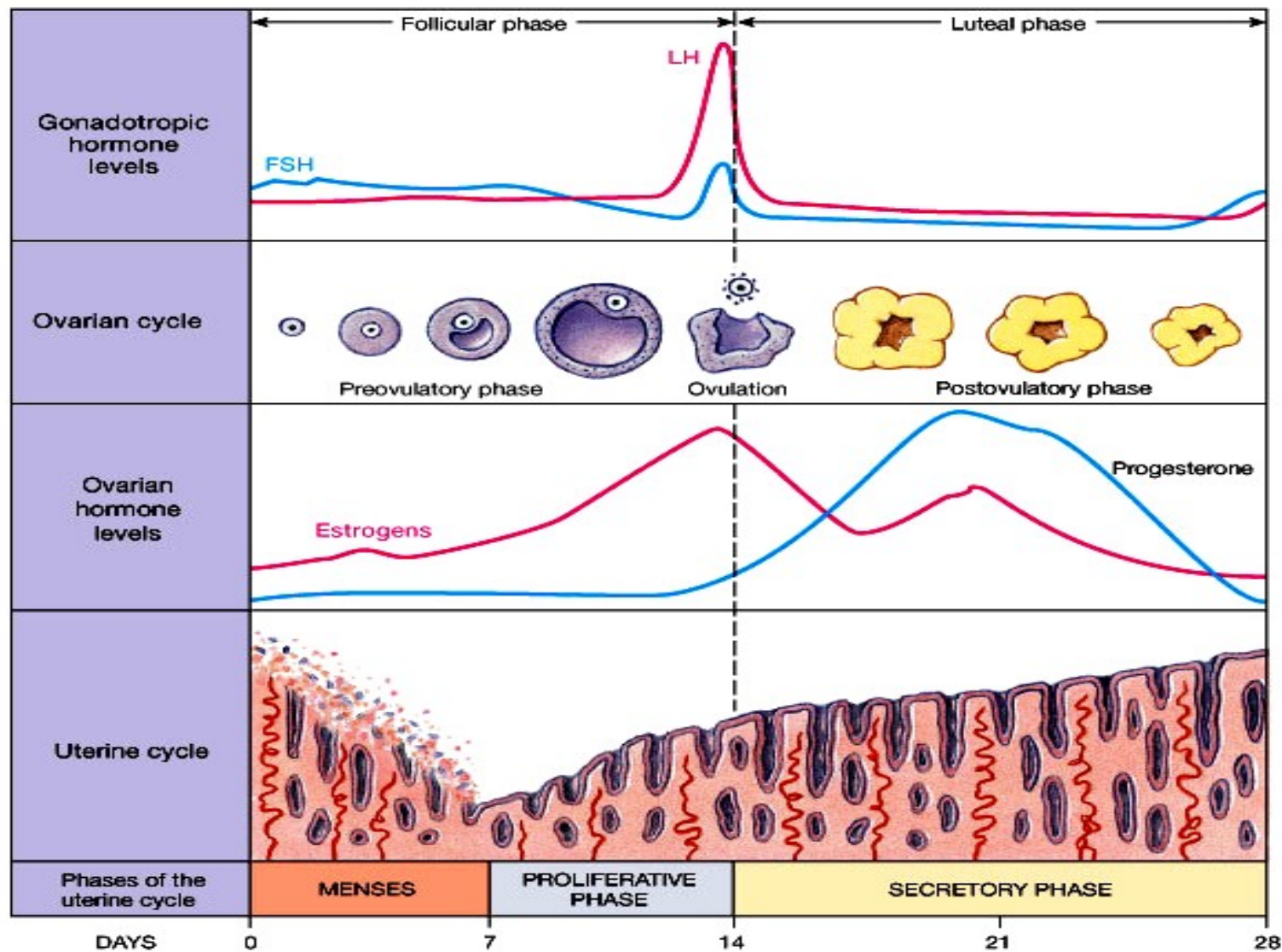
(Menstruation)

Proliferative Phase



(Estrogen Phase)

- **Coincides with last portion of follicular phase**
- **Lasts from end of menstrual phase to beginning of ovulation**
- **Is dominated by estrogen secretion by**



<https://quizlet.com/ca/230699176/uterineovarian-cycle-diagram/>



❖ **Estrogen**

→ stimulates proliferation of epithelial cells, glands & blood vessels in endometrium

→ endometrium ↑ rapidly in thickness

❖ **The uterine glands ↑ in length but do not secrete.**

❖ **High estrogen levels**

→ **LH surge responsible for ovulation**

Secretory Phase



(Progestational Phase)

- **Coincides with ovarian luteal phase**
- **Is dominated by progesterone & estrogen secreted by corpus luteum**



❖ Estrogen

→ causes slight additional cellular proliferation in the endometrium



Progesterone

- ❖→ endometrium become more highly vascularized and slightly edematous.**
- ❖→ endometrial glands become coiled and tortuous, secrete a clear fluid**
- ❖And are storing glycogen for early nourishment of a developing embryo before it implants.**



❖ **The secretory phase**

→ prepares the uterus for implantation of a fertilized ovum and supporting an early embryo after implantation.

Menstrual Phase



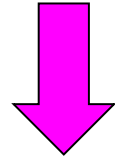
(Menstruation)

- ❖ **Coincides with termination of ovarian luteal phase & onset of new follicular phase**
- ❖ **First day of menstruation is start of new ovarian cycle**
- ❖ **Characterized by discharge of blood & endometrial debris from vagina 2 days after**

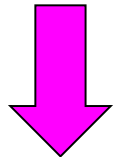
Cause of Menstruation



Degeneration of corpus luteum



Sharp ↓ estrogen & progesterone

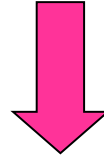


❖ **Deprivation of endometrium from hormonal support → involutes & ↓ thickness**

❖ **Release of uterine prostaglandin**



Release of Uterine Prostaglandin



❖ **V.C. of endometrial blood vessels**

→ necrosis of endometrium

→ entire uterine lining sloughs except a deep thin layer of epithelial cells & glands from which new endometrium will regenerate

❖ **Contraction of uterine myometrium to expel blood & endometrial debris from uterine cavity**

Normal Menstruation



- ❖ **Menstrual blood is mainly arterial & only 25% is venous.**
- ❖ **Contains**
 - **tissue debris**
 - **prostaglandins**
 - **relatively large amounts of fibrinolysin from endometrial tissue.**



- ❖ **Blood usually does not clot because the fibrinolysin lyses clots.**
- ❖ **Only when the flow is excessive blood clots may appear**
- ❖ **Because it may not have sufficient time to be exposed to fibrinolysin.**
- ❖ **Large numbers of leukocytes are found in the menstrual flow**
- ❖ **→ an important defense role in helping the raw endometrium to resist infection.**



❖ **The usual duration of the menstrual flow is 3-5 days, (1-8 days can occur in normal women).**

❖ **The amount of blood lost may range normally from slight spotting to 80 mL the average amount lost is 30 mL**

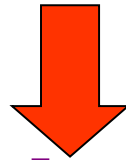
❖ **Loss of more than 80 ml is abnormal**

Dysmenorrhea

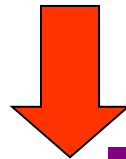


(Painful menstruation)

Overproduction of prostaglandin



Excessive uterine contractions



Menstrual cramps

Anovulatory Cycles



- ❖ **Are menstrual cycles without ovulation due to insufficient LH surge.**
- ❖ **Anovulatory cycles are common for**
 - ▶ **first 12-18 months after onset of puberty**
 - ▶ **before the onset of menopause**



❖ **When ovulation does not occur**

→ no corpus luteum is formed

→ no secretion of progesterone

→ effects of progesterone on

endometrium are absent



❖ Estrogens

- growth of the endometrium
- proliferative endometrium becomes thick enough to break down and begins to slough
- bleeding



❖ **The menstrual cycles are**

▶ **shorter than normal**

▶ **cannot lead to pregnancy**

❖ **The flow is variable**

Lecture Quiz



1. For a typical 28 day menstrual cycle, what portion of the ovarian and uterine cycles, respectively, correspond to day 27?

Ovarian cycle phase-Uterine cycle phase

- A. Luteal Proliferative**
- B. Luteal Secretory**
- C. Follicular Proliferative**
- D. Ovulatory secretory**
- E. Follicular secretory**

2. Which of the following is characteristic of the secretory phase of the menstrual cycle?

- 1. It produces ischemia and necrosis of the stratum functionale.**
- 2. It is controlled by estrogen**
- 3. It ends upon arrival of ovulation**
- 4. Uterine gland lumens are filled with secretions.**

SUGGESTED TEXTBOOKS



- 1. Ganong's Review of Medical Physiology. 25th edition.**
- 2. Guyton and Hall. Textbook of Medical Physiology. Thirteenth edition.**
- 3. Introduction to Human Physiology. Lauralee Sherwood. 8th edition.**

